In two previous Hot Topics (October 2000 and January 2001) we described how user performance expectations increase over time - image resolution, colour depth, contrast ratio, frame rate (video streaming) and application performance. In this month's Hot Topic we set out to show how to quantify content value, how to use content value as the basis of bandwidth negotiation, how to use content value as the basis for billing by quality rather than quantity.

**Figure 1: Subjective Quality**
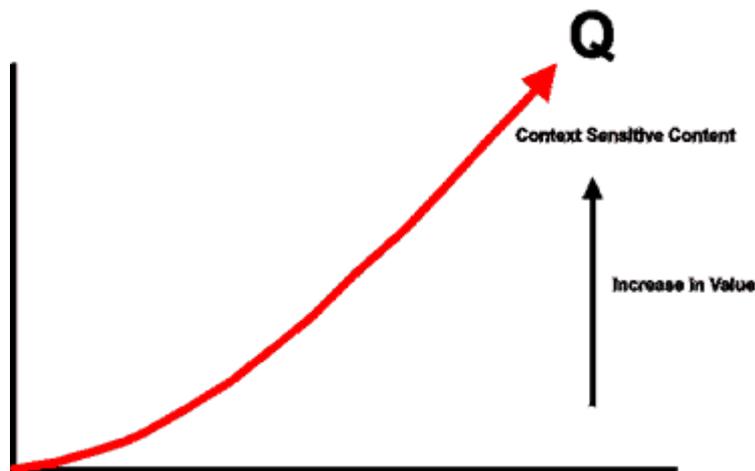


Figure 1 shows the increase in value relative to a subjective assessment of content quality, for example, content can have entertainment value or information value. The information may increase or decrease in value over time - ie it may be time or context sensitive.

**Figure 2: Objective Quality**
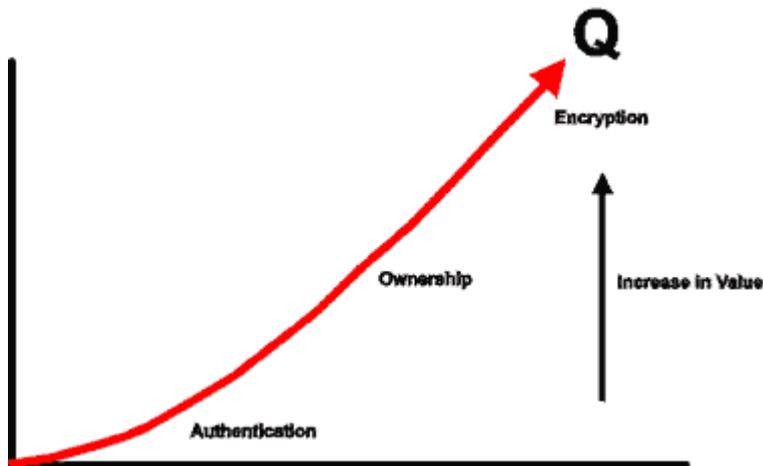
Figure 2 shows how we can add value to content through proof of ownership (digital watermarking and codification of ownership rights) and encryption - a 2048 bit key has more 'value' than a 1024 bit key in terms of encryption security, an objective differentiation.

**Figure 3**: Objective Quality
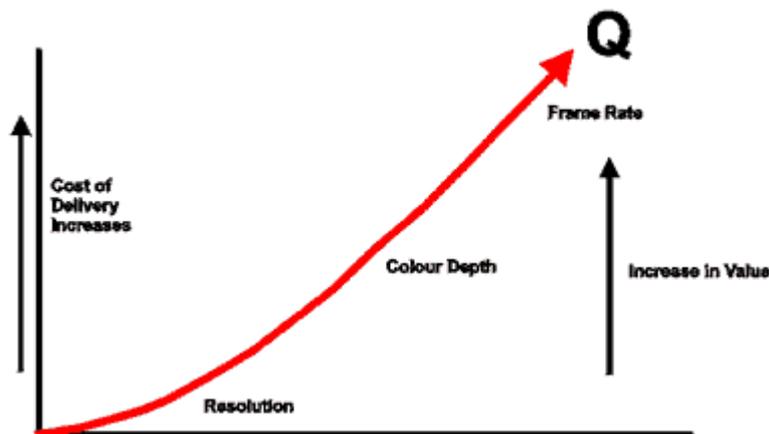


Figure 3 shows how content value can be increased by improving resolution, colour depth and frame rate. A 24 bit per pixel colour depth giving 16 million colours has more 'value' than a 4 bit per pixel colour depth giving 16 shades of grey. A 25 frame per second video stream has more value than a 5 frame per second video stream. A 3.2 megapixel image has more 'value' than a 1.6 megapixel image.

Image quality is codified in the J-PEG standard. In J-PEG, 8 x 8 pixel blocks are transformed to the frequency domain, differences between blocks are expressed in terms of difference co-efficients. A 'Q' factor of 100 means that pixel blocks must be identical for there to be no difference co-efficients. Lower Q factors allow differences between pixel blocks to be ignored, ie image quality is allowed to degrade. The higher the 'Q', the higher the 'value' of the content.

**Figure 4: Objective Quality**
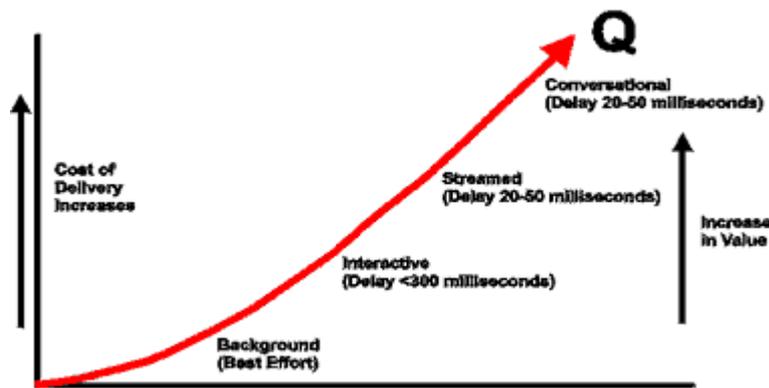


Figure 4 shows how elapsed time can be a component in content value - Interactive media has more value than background, streamed media has more value than interactive, conversational exchanges have more value than streamed media. Note however that as content value increases (Figures 3 and 4) the cost of delivery goes up. We have to be sure that added value increases faster than cost of delivery to avoid AMPU (average margin per user) being reduced.

**Figure 5: Media Multiplex**
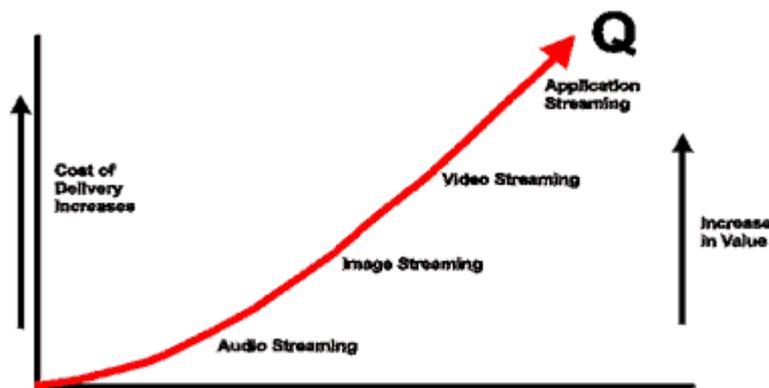


Figure 5 shows how value can also be related to the media mix, audio value (voice) can be enhanced by (simultaneous) image, video and application streaming.

Quality based billing models are already used in the television industry - conditional access over cable, satellite and terrestrial TV is based on subjective content quality (you pay more for a popular football match).

Digital TV (DVB - digital video broadcasting) adds differentiation on the basis of objective quality metrics - for example (in the longer term), the ability to pay a premium for enhanced definition (EDTV), high definition (1080 lines x 1920 pixels per line) or multi-media data broadcasting (video and application streaming). Effectively

the DVB standard establishing the basis for pixel pricing - billing by quality not quantity.

Note also how MP4 meta tagging can be used to describe the QoS metrics needed to preserve content value, isochronous or non-isochronous packet streaming, buffer and timing requirements, time stamping and synchronisation.

Figure 5 also reveals an additional value component - how a session can increase in value from start to finish. For example, a simple voice exchange may lead on to the exchange of images, may lead on to an exchange of video clips, may lead on to interactive/streamed media or a 'conversational media' exchange, a low resolution low frame rate exchange may need to be upgraded to a high frame rate (action packed) high resolution exchange.

Content based value based billing using a combination of subjective and objective quality metrics provides substantially higher tariff differentiation opportunities than conventional volume based billing and will likely be the only way in which the 3G business model can be rationalised and realised over the next 5 years.

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We aim to introduce new terminology and new ideas to clarify present and future technology and business issues.

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## Contact RTT

RTT, the Shosteck Group and The Mobile World are presently working on a number of research and forecasting projects in the cellular, two way radio, satellite and broadcasting industry.

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